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(54) **APPARATUS WITH ROTATABLE ARM FOR UNWINDING STRANDS OF MATERIAL**

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CPC ***B65H 57/20*** (2013.01); ***B65H 57/14*** (2013.01); *B65H 2701/31* (2013.01)

(58) **Field of Classification Search**
CPC B65H 57/14; B65H 57/20; B65H 2701/31
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See application file for complete search history.

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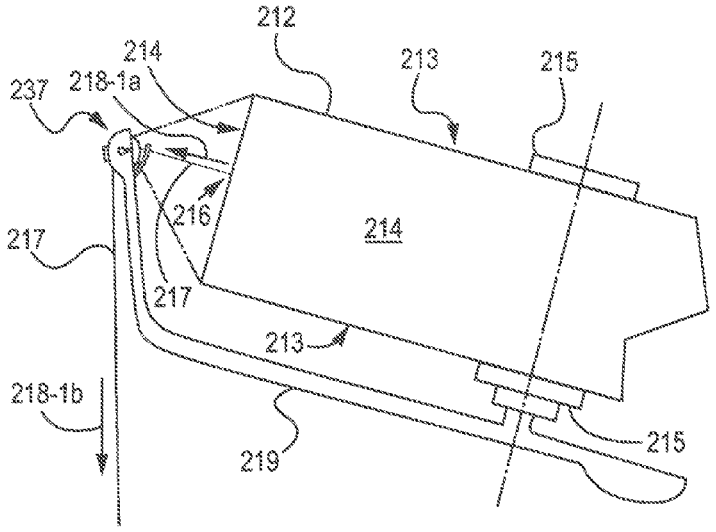
(57) **ABSTRACT**

An apparatus with a rotatable arm for unwinding a strand by taking it off of the side of a wound package.

16 Claims, 9 Drawing Sheets



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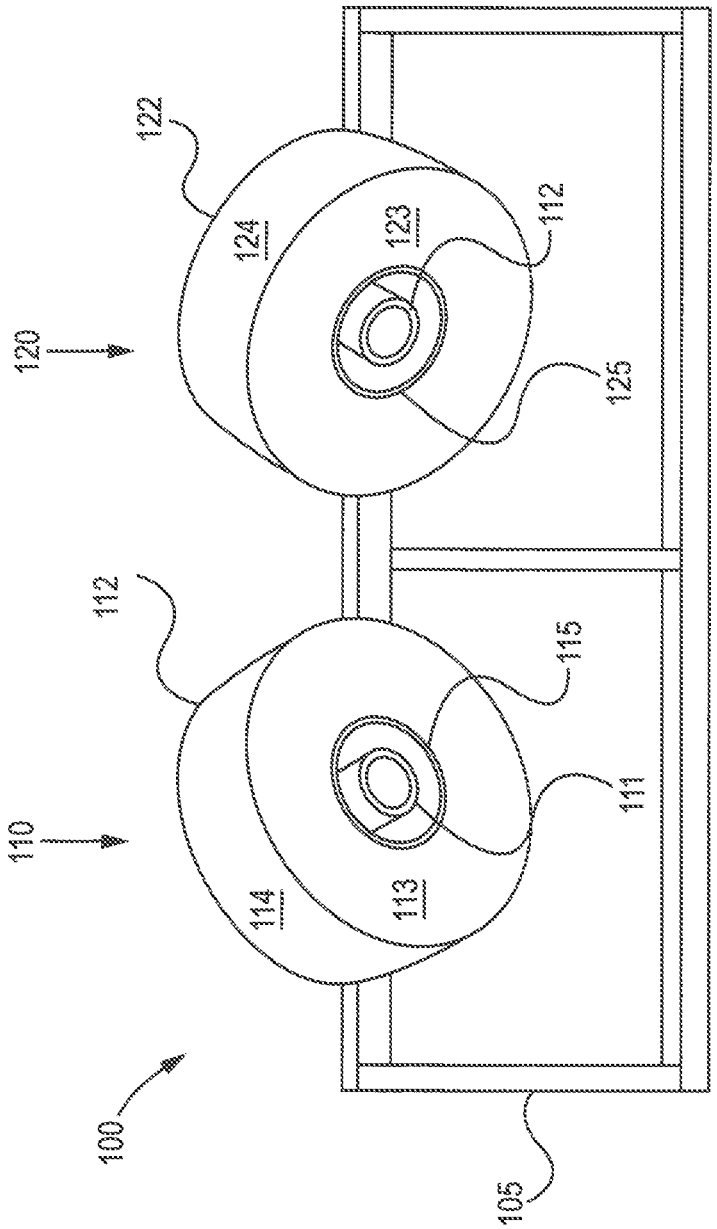

Fig. 1A
PRIOR ART

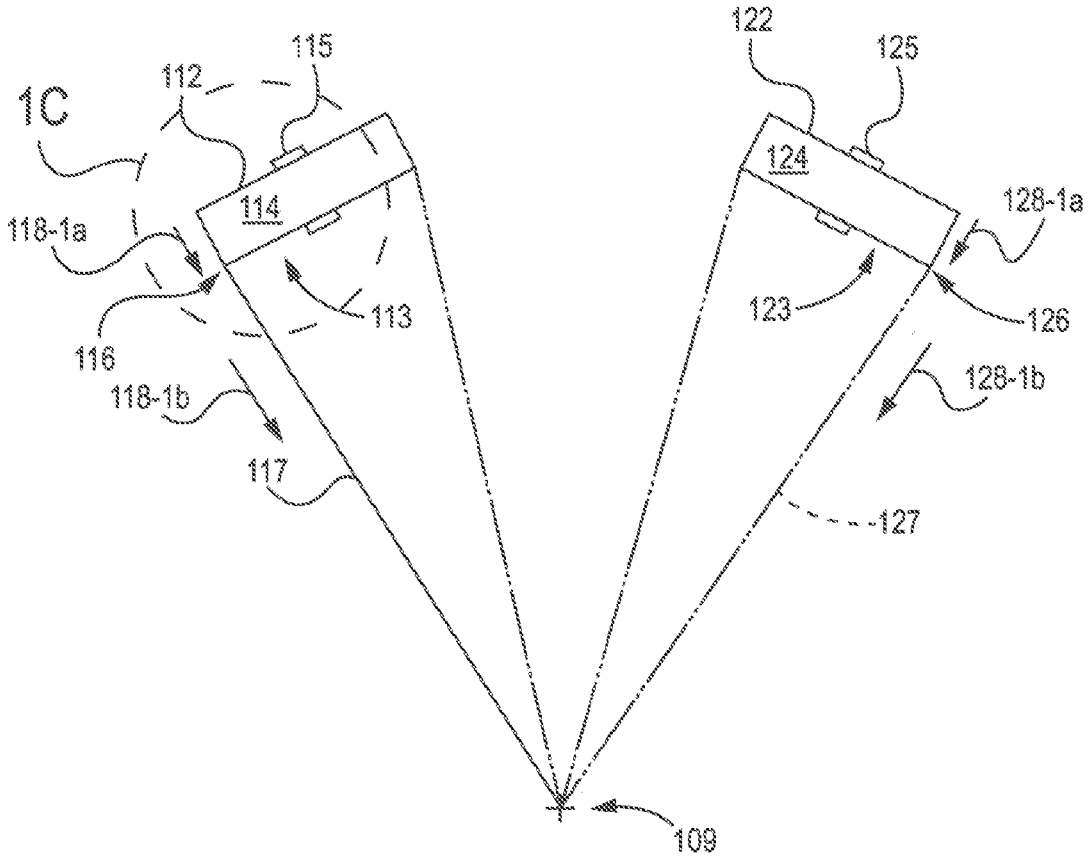

Fig. 1B
PRIOR ART

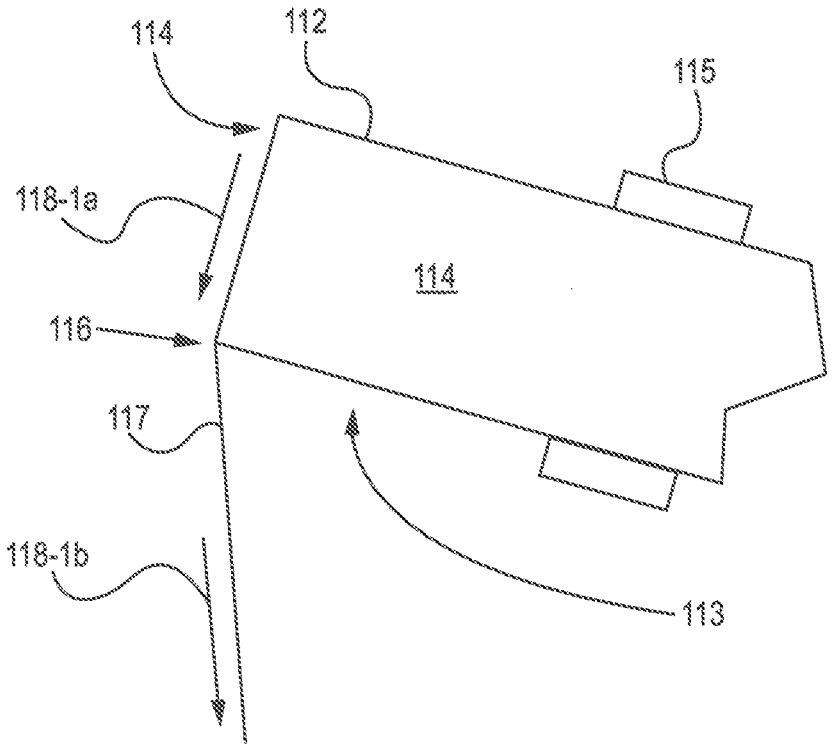

Fig. 1C
PRIOR ART

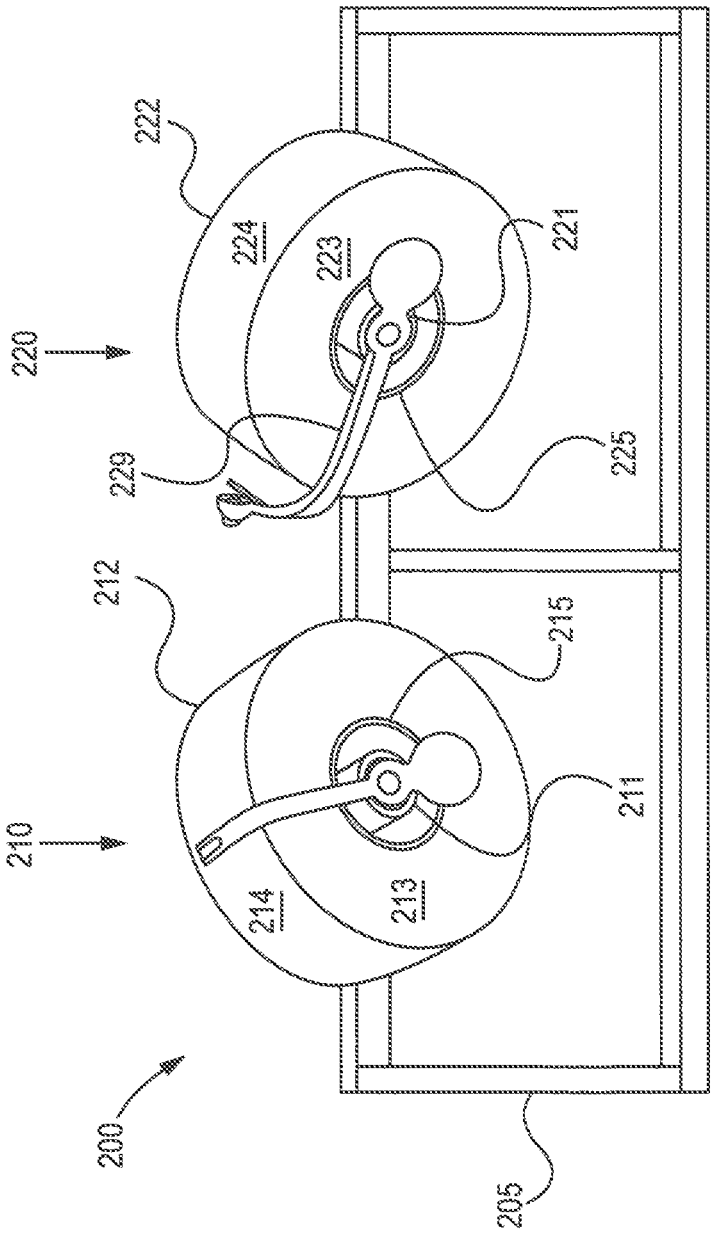

Fig. 2A

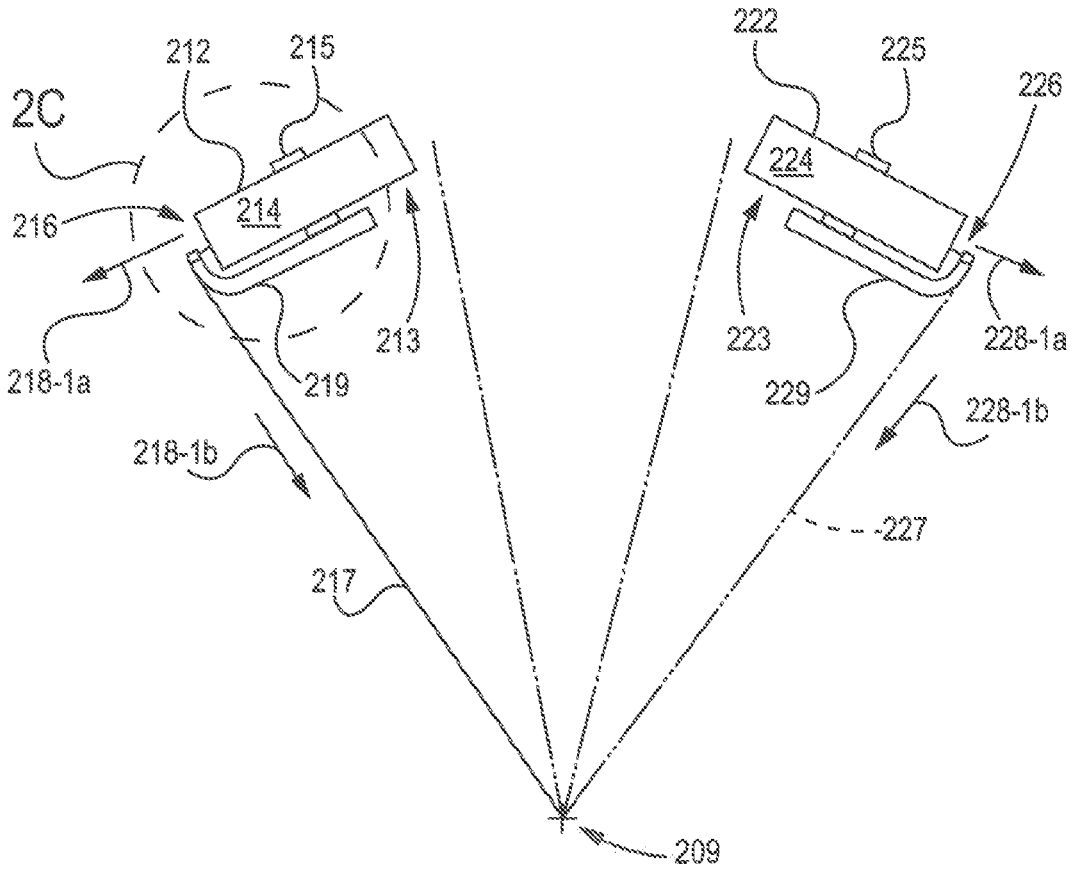
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Fig. 2B

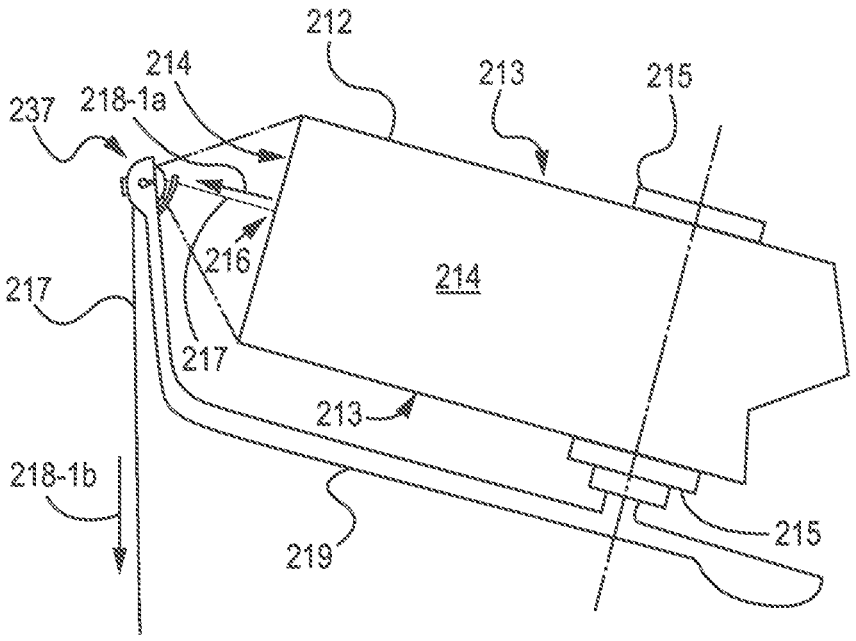

Fig. 2C

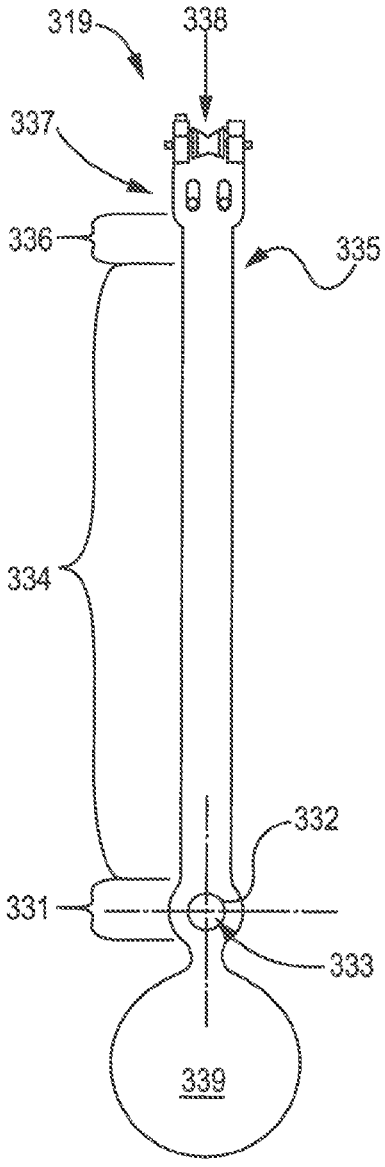
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Fig. 3A

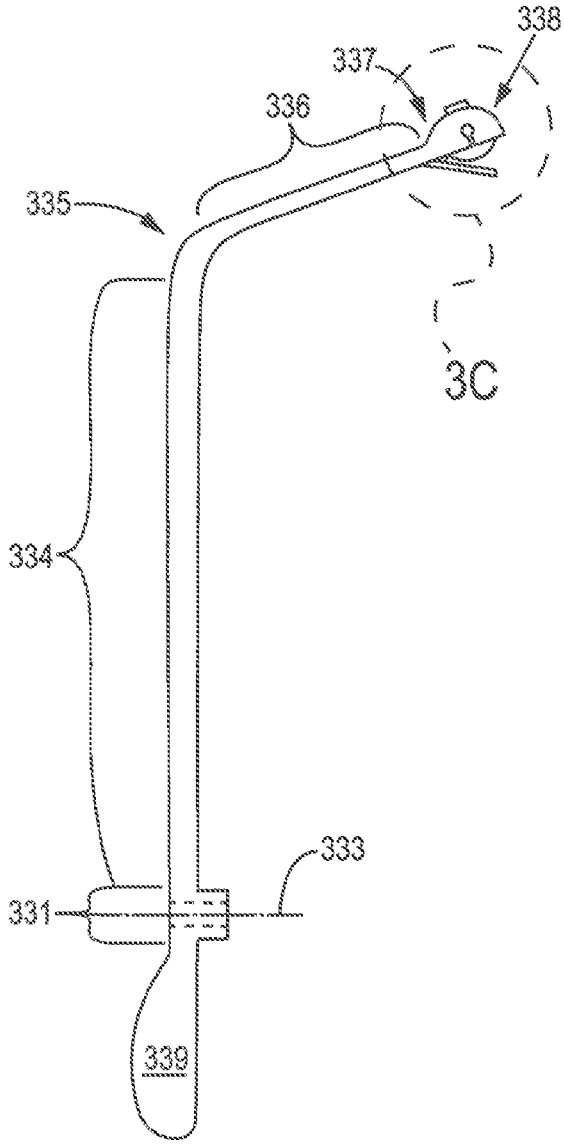
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Fig. 3B

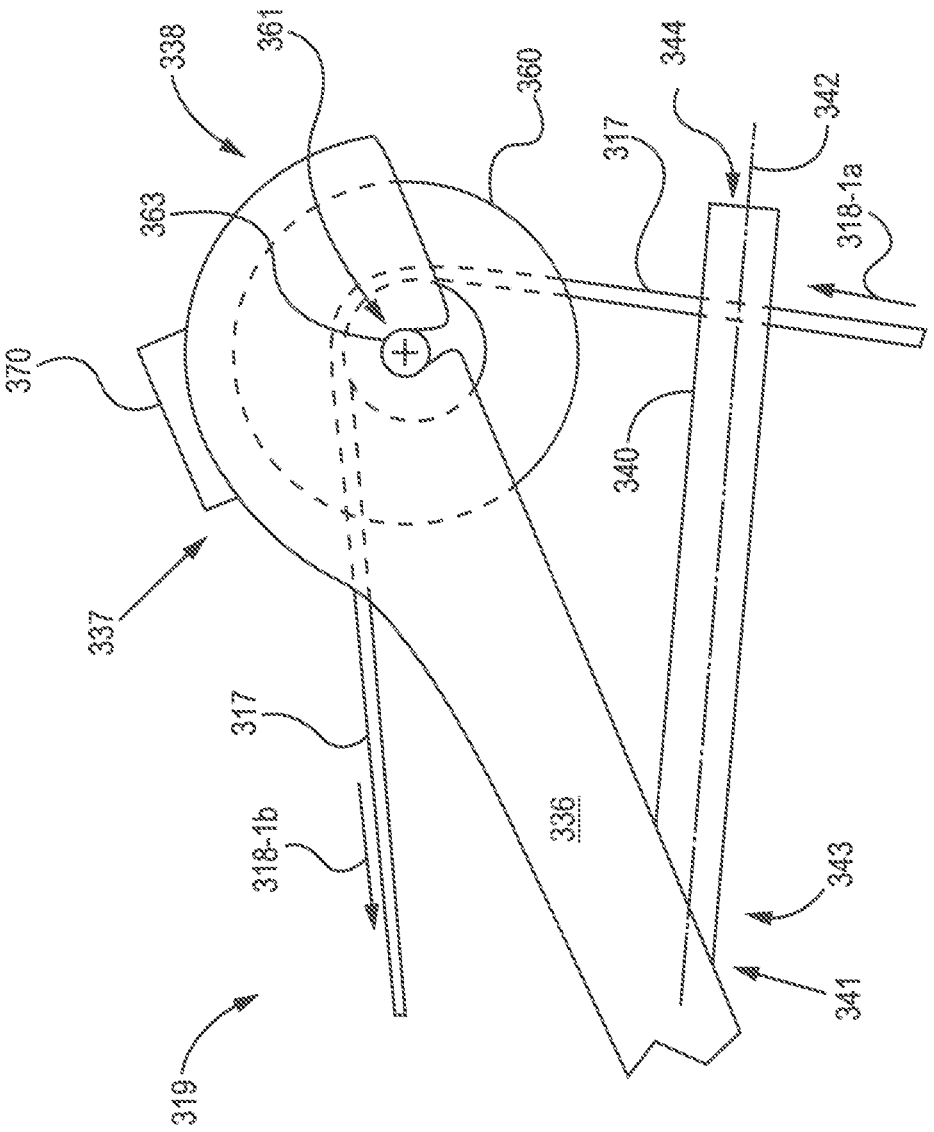
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Fig. 3C

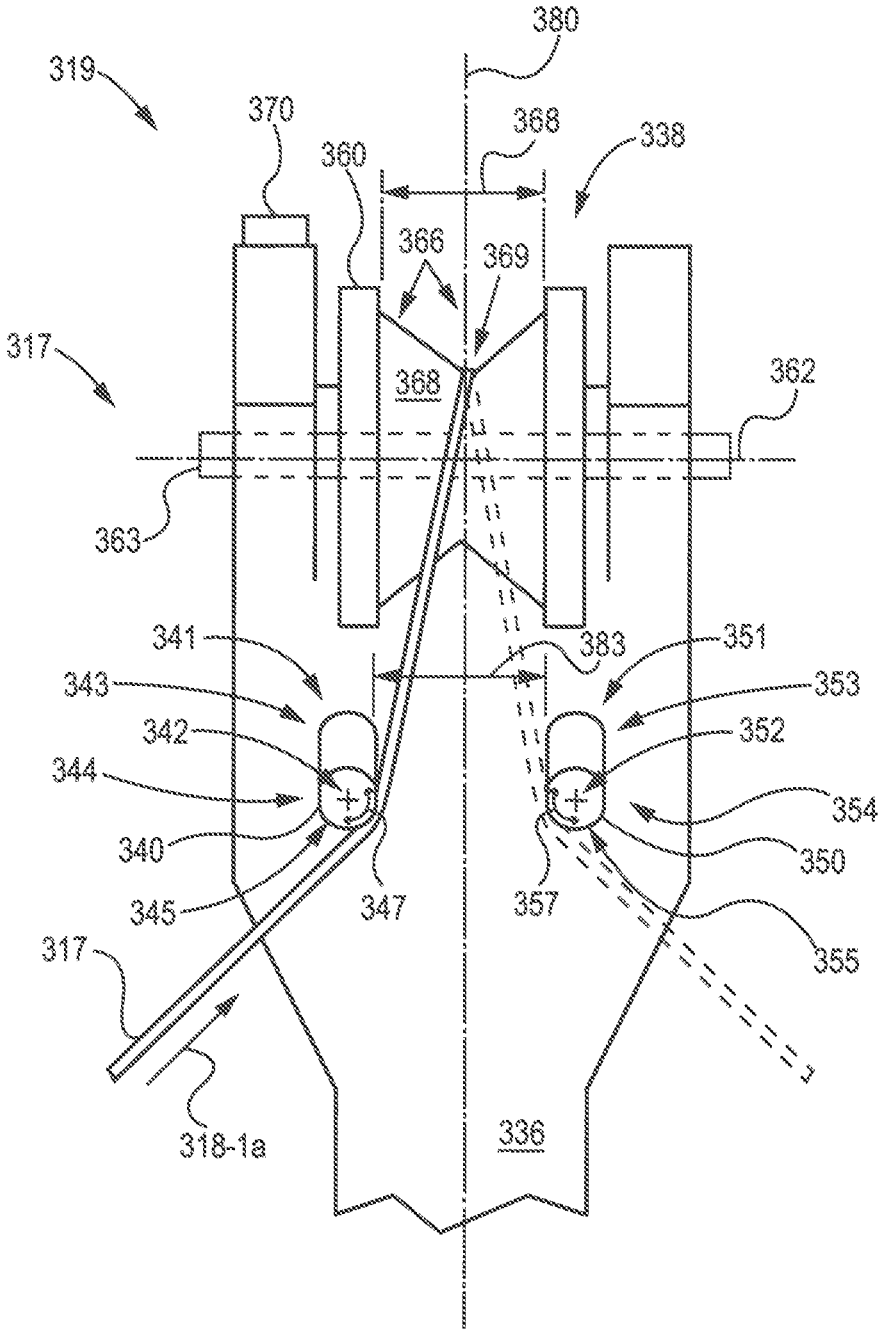
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Fig. 3D

APPARATUS WITH ROTATABLE ARM FOR UNWINDING STRANDS OF MATERIAL

FIELD

The present disclosure relates to an apparatus for unwinding strands of material from wound packages. In particular, the present disclosure relates to an apparatus with a rotatable arm for unwinding a strand by taking it off of the side of a wound package.

BACKGROUND

Over End Take-Off equipment is used to unwind strands of material that have been pre wound onto cores. The pre-wound cores are called packages. Over End Take-Off equipment unwinds a strand by taking it off over the end of the package. The Over End Take-Off equipment then feeds the unwound strand to downstream equipment.

During the unwinding process, the strand experiences friction as it is being taken off. As a strand is being taken off, the strand may also experience adhesive and/or cohesive forces that stick the strand to the underlying material of the package. Due to friction and sticking forces, the strand resists being taken off over the end of the package. As a result of this resistance, during the unwinding, the strand may experience high tension and/or variable tensions, which make reliable processing more difficult.

Further, as a strand is being taken off, portions of the strand may encounter sticking forces that are quite large, when compared to the strength of the strand. When the strand is taken off over the end of the package, the strand is pulled across the side of the package. When the strand is pulled across the side of the package, the tension in the strand attempts to overcome the sticking forces by shearing the stuck portion away from the side. However, in this mode, the strand may experience a high tension that breaks the strand, resulting in downtime for the equipment.

SUMMARY

Embodiments of the present disclosure use a rotatable arm to unwind a strand by taking it off of the side of a wound package. Using the rotatable arm reduces the friction as the strand is being taken off, which is especially useful for tacky strands. As a result, the strand experiences lower tension with less variability. Using the rotatable arm also tends to peel stuck portions away from the side, so that a lower tension in the strand can overcome the sticking forces. As a result, the strand experiences fewer instances of high tension, which leads to fewer breaks and less downtime for the equipment.

BRIEF DESCRIPTIONS OF DRAWINGS

FIG. **1**A illustrates a front elevation view of a prior art Over End Take-Off apparatus for unwinding strands of material from wound packages.

FIG. **1**B illustrates a top view of the packages of FIG. **1**A, in a prior art Over End Take-Off configuration, for unwinding strands to a downstream infeed location.

FIG. **1**C illustrates an enlarged top view of a portion of one the packages of FIG. **1**B, in a prior art Over End Take-Off configuration, for taking a strand off over an end of the package.

FIG. **2**A illustrates a front elevation view of an apparatus for unwinding strands of material from wound packages, wherein the apparatus includes rotatable arms of the present disclosure.

FIG. **2**B illustrates a top view of the packages and the rotatable arms of FIG. **2**A, configured according to the present disclosure, for unwinding strands to a downstream infeed location.

FIG. **2**C illustrates an enlarged top view of a portion of one the packages and one of the rotatable arms of FIG. **2**B, configured according to the present disclosure, for taking a strand off a side of the package.

FIG. **3**A illustrates a front view of the rotatable arm of FIG. **2**A.

FIG. **3**B illustrates a side view of the rotatable arm of FIG. **3**A.

FIG. **3**C illustrates an enlarged side view of the head of the rotatable arm of FIG. **3**B, taking a strand off a side of a package.

FIG. **3**D illustrates an enlarged front view of the head of the rotatable arm of FIG. **3**C, taking a strand off a side of a package.

DETAILED DESCRIPTION

Embodiments of the present disclosure use a rotatable arm to unwind a strand by taking it off of the side of a wound package. Using the rotatable arm reduces the friction as the strand is being taken off, which is especially useful for tacky strands. As a result, the strand experiences lower tension with less variability. Using the rotatable arm also tends to peel stuck portions away from the side, so that a lower tension in the strand can overcome the sticking forces. As a result, the strand experiences fewer instances of high tension, which leads to fewer breaks and less downtime for the equipment.

Embodiments of the present disclosure can be used with all kinds of strands (and bands), of various sizes and shapes, made from different materials. For example, embodiments of the present disclosure can be used to unwind string, elastic, metal wire, etc.

FIG. **1**A illustrates a front elevation view of a prior art Over End Take-Off apparatus **100** for unwinding strands of material from wound packages. The Over End Take-Off apparatus **100** includes a first package unwind station **110** and a second package unwind station **120**, mounted to a frame **105**. The first package unwind station **110** includes a first holder **111** for holding a package, and the second package unwind station **120** includes a second holder **112** for holding a package.

In FIG. **1**A, a first package **112** is loaded into the first package unwind station **110**. The first package **112** includes a strand of material wound onto a cylindrical core **115**. The first package **112** also has an overall shape that is cylindrical, with substantially flat ends **113** and a side **114**, which is the curved surface around the circumference of the cylindrical shape.

Also, in FIG. **1**A, a second package **122** is loaded into the second package unwind station **120**. The second package **122** includes a strand of material wound onto a cylindrical core **125**. The second package **122** also has an overall shape that is cylindrical, with substantially flat ends **123** and a side **124**, which is the curved surface around the circumference of the cylindrical shape.

FIG. **1**B illustrates a top view of the packages **112** and **122** of FIG. **1**A, in a prior an Over End Take-Off configuration, for unwinding strands to a downstream infeed location **109**. The front ends **113** and **123** of the packages **112** and **122** are angled toward the downstream infeed location **109**.

In FIG. **1**B, the first package **112** is the active package and the second package **122** is the standby package. In FIG. **1**B, the Over End Take-Off apparatus (not shown) is unwinding a first strand **117** of material from the first package **112**. Downstream equipment creates process tension in the first strand

117 and pulls the first strand 117 to the downstream infeed 109. As a result, the first strand 117 is pulled across 118-1*a* the side 114 of the first package 112, and the first strand 117 is taken off of the first package 112 in a first take-off direction 118-1*b*, which is a substantially straight line from a take-off point 116 on one side of the outer edge of the front end 113 of the first package 112 to the downstream infeed location 109.

Since the first strand 117 is pre-wound around the cylindrical outer surface of the first package 112, as the first strand 117 is unwound, the take-off point 116 moves in a circular motion, around the outer edge of the front end 113 of the first package 112, and the first take-off direction 118-1*b* follows. From the perspective of the downstream infeed location 109, the first strand 117 may unwind in a clockwise or counterclockwise direction, depending on how the first package 112 is wound and how the first package 112 is loaded into the first package station 110. The extent of the first take-off direction 118-1*b* is indicated by the phantom line that extends from the other side of the outer edge of the front end 113 of the first package 112 to the downstream infeed location 109.

After the second package 122 becomes the active package, the Over End Take-Off apparatus unwinds a second strand 127 of material from the second package 122. Downstream equipment creates process tension in the second strand 127 and pulls the second strand 127 to the downstream infeed 109. As a result, the second strand 127 is pulled across 128-1*a* the side 124 of the second package 122, and the second strand 127 is taken off of the second package 122 in a second take-off direction 128-1*b*, which is a substantially straight line from a take-off point 126 on one side of the outer edge of the front end 123 of the second package 122 to the downstream infeed location 109.

Since the second strand 127 is pre-wound around the cylindrical outer surface of the first package 122, as the second strand 127 is unwound, the take-off point 126 moves in a circular motion, around the outer edge of the front end 123 of the second package 122, and the second take-off direction 128-1*b* follows. From the perspective of the downstream infeed location 109, the second strand 127 may unwind in a clockwise or counterclockwise direction, depending on how the second package 122 is wound and how the second package 122 is loaded into the second package station 120. The extent of the second take-off direction 128-1*b* is indicated by the second phantom line that extends from the other side of the outer edge of the front end 123 of the second package 122 to the downstream infeed location 109.

FIG. 1C illustrates an enlarged top view of a portion of the first package 112 of FIG. 1B, in a prior art Over End Take-Off configuration, for taking the strand 117 off over the front end 113 of the package.

FIG. 2A illustrates a front elevation view of an apparatus 200 for unwinding strands of material from wound packages, wherein the apparatus 200 includes rotatable arms of the present disclosure. The apparatus 200 includes a first package unwind station 210 and a second package unwind station 220, mounted to a frame 205. The first package unwind station 210 includes a first holder 211 for holding a package, and the second package unwind station 220 includes a second holder 221 for holding a package. The first package unwind station 210 includes a first rotatable arm 219, and the second package unwind station 220 includes a second rotatable arm 229. The first arm 219 and the second arm 229 can each configured in the same way as the arm 319 of FIGS. 3A-3D, including any of its alternative embodiments.

In FIG. 2A, a first package 212 is loaded into the first package unwind station 210. The first package 212 includes a strand of material wound onto a cylindrical core 215. The first package 212 also has an overall shape that is cylindrical, with substantially flat ends 213 and a side 214, which is the curved surface around the circumference of the cylindrical shape. The first rotatable arm 219 is configured to unwind a strand from the first package 212 to a downstream infeed location.

Also, in FIG. 2A, a second package 222 is loaded into the second package unwind station 220. The second package 222 includes a strand of material wound onto a cylindrical core 225. The second package 222 also has an overall shape that is cylindrical, with substantially flat ends 223 and a side 224, which is the curved surface around the circumference of the cylindrical shape. The second rotatable arm 229 is configured to unwind a strand from the second package 222 to the downstream infeed location.

FIG. 2B illustrates a top view of the packages 212 and 222 and the rotatable arms 219 and 229 of FIG. 2A, configured according to the present disclosure, for unwinding strands to a downstream infeed location 209. The front ends 213 and 223 of the packages 112 and 122 are angled toward the downstream infeed location 209.

In FIG. 2B, the first package 212 is the active package and the second package 222 is the standby package. In FIG. 2B, the apparatus is unwinding a first strand 217 of material from the first package 212. Downstream equipment creates process tension in the first strand 217 and pulls the first strand 217 to the downstream infeed 209. Strand guides on the first rotatable arm 219 constrain and direct the path of the strand 217 between the first package 212 and the downstream infeed 209. As a result, the first strand 217 is taken off of the first package 212 from a take-off point 216 on the side 214 of the first package 212. From the takeoff point 216, the first strand 217 is pulled up and away from the side 214 in a first take-off direction 218-1*a*, and over the strand guides on the first rotatable arm 219. After the first strand 217 leaves the strand guides on the first rotatable arm 219, the first strand 217 is directed in a first infeed direction 218-1*b*, which is a substantially straight line from a downstream strand guide on the first rotatable arm 219 to the downstream infeed location 109.

Since the first strand 217 is pre-wound around the cylindrical outer surface of the first package 212, as the first strand 217 is unwound, the take-off point 216 moves in a spiral motion, around the side 214 of the first package 212, and the first rotatable arm 219 follows with a circular motion. From the perspective of the downstream infeed location 209, the first strand 217 may unwind in a clockwise or counterclockwise direction, depending on how the first package 212 is wound and how the first package 212 is loaded into the first package station 210. The strand guides on the first rotatable arm 219 are configured to unwind in either the clockwise or counterclockwise direction. The extent of the first infeed direction 218-1*b* is indicated by the phantom line that extends from the opposite part of the side 214 of the first package 212 to the downstream infeed location 209.

After the second package 222 becomes the active package, the apparatus unwinds a second strand 227 of material from the second package 222. Downstream equipment creates process tension in the second strand 227 and pulls the second strand 227 to the downstream infeed 209. Strand guides on the second rotatable arm 229 constrain and direct the path of the strand 227 between the second package 222 and the downstream infeed 209. As a result, the second strand 227 is taken off of the second package 222 from a take-off point 226 on the side 224 of the second package 222. From the take-off point 226, the second strand 227 is pulled up and away from the side 224 in a first take-off direction 228-1*a*, and over the strand guides on the second rotatable arm 229. After the second strand 227 leaves the strand guides on the second rotatable

arm **229**, the second strand **227** is directed in a second infeed direction **228-1***b*, which is a substantially straight line from a downstream strand guide on the second rotatable arm **229** to the downstream infeed location **209**.

Since the second strand **227** is pre-wound around the cylindrical outer surface of the second package **222**, as the second strand **227** is unwound, the take-off point **226** moves in a spiral motion, around the side **224** of the second package **222**, and the second rotatable arm **229** follows with a circular motion. From the perspective of the downstream infeed location **209**, the second strand **227** may unwind in a clockwise or counterclockwise direction, depending on how the second package **222** is wound and how the second package **222** is loaded into the second package station **220**. The strand guides on the second rotatable arm **229** are configured to unwind in either the clockwise or counterclockwise direction. The extent of the second infeed direction **228-1***b* is indicated by the phantom line that extends from the opposite part of the side **224** of the second package **222** to the downstream infeed location **209**.

FIG. **2**C illustrates an enlarged top view of a portion of the first package **212** and the first rotatable arm **219** of FIG. **2**B, for taking the first strand **217** off the side **214** of the first package **212**. The strand guides of the first rotatable arm **219** are disposed in a head **237** of the first rotatable arm **219**. When the first rotatable arm **219** is in position at the first package unwind station **210**, the head **237** (and the strand guides) of the first rotatable arm **219** are offset from the outer surface of the package **212**, radially outward from the side **214**.

The first strand **217** is taken off of the first package **212** from a take-off point **216** on the side **214** of the first package **212**. From the take-off point **216**, the first strand **217** is pulled up and off of the side **214** in the first take-off direction **218-1***a*, which extends radially outward from the centerline of the first package **212**.

Since the first strand **217** is pre-wound around the first package **222**, back and forth from the front end **213** to the back end **213**, as the first strand **217** is unwound, the take-off point **216** moves in an oscillating motion, back and forth across the side **214** of the first package **212**, and the first take-off direction **218-1***a* follows. The extent of the first take-off direction **218-1***a* is indicated by the phantom lines that extend from the front and back edges of the side **214** of the first package **212** to the strand guides on the head **237** of the first rotatable arm **219**.

As shown by the phantom lines in FIG. **2**C, the orientation of the first take-off direction **218-1***a* can vary with respect to the side **214**, as the first strand **217** is unwound. However, in each orientation, the first take-off direction **218-1***a* has a significant directional component extending radially outward from the centerline of the first package **212**. That is, despite the movement of the take-off point **216**, due to the location of the head **237** and the circular motion of the first rotatable arm **219**, the first strand **217** is always being pulled up and off of the side **214**.

In the embodiment of FIG. **2**C, the head **237** of the rotatable arm **219** is shown about halfway between the front **213** and the back **213** of the first package **214**; however, this particular position is not required. In various embodiments, the length of the rotatable arm **219** can be selected to position the head **237** closer to the front **213** or closer to the back **213**. In a particular exemplary embodiment, the head **237** can be positioned proximate to the back **213** of the package **214**, so that, during the unwind process, the first strand **217** is less likely to be pulled off the end of the upstream strand guides, as described in connection with FIGS. **3**A-**3**C.

By using the first rotatable arm **219**, an apparatus can unwind the first strand **217** by taking it off of the side **214** of the first package **212**. When compared with the prior art approach of Over End Take-Off, using the first rotatable arm **219** reduces the friction as the first strand **214** is being taken off, which is especially useful for tacky strands. As a result, the first strand **214** experiences lower tension with less variability, which makes reliable processing less difficult.

Further, by using the first rotatable arm **219**, stuck portions of the first strand **217** can be pulled up, off of the side **214** instead of being pulled across the side **214**. With the pulling up in the first take-off direction **218-1***a*, the adhesion and/or cohesion of the stuck portions can be peeled away from the side **214** instead of being sheared off of the side **214**, to overcome the sticking. As a result, the first strand **214** experiences fewer instances of high tension, which leads to fewer breaks and less downtime for the equipment.

The second rotatable arm **229** is configured in the same way as the first rotatable arm **219**, with respect to its structure, function, and benefit.

FIG. **3**A illustrates a front view of a rotatable arm **319**, which can be used as either or both of the rotatable arms **219** and **229** of FIGS. **2**A-**2**C. The rotatable arm **319** includes a base **331** with a mounting hole **332**, and a rotational axis **333** passing through the center of the mounting hole **332**. A first extended portion **334** is attached to one side of the base **331** and a counterbalance **339** is attached to the other side of the base **331**. A second extended portion **336** is attached to the first extended portion **334**. A bend **335** in the rotatable arm **319** separates the first extended portion **334** from the second extended portion **336**, and sets the portions at an angle with respect to each other. The length of the first extended portion **334** and the second extended portion, as well as the angle of the bend **335** can be selected according to the overall dimensions of the packages to be unwound by the rotatable arm **319**. The rotating arm **319** can be made from various solid materials that are rigid and sturdy. For example, the rotatable arm **319** can be made from plastic, metal, ceramic, wood, etc.

A head **337** of the rotatable arm **319** is attached to the second extended portion **336**. The end of the head **337** terminates at a distal end **338** of the rotatable arm **319**. The head **337** of the rotatable arm **319** includes several strand guides, described and illustrated in connection with FIGS. **3**C and **3**D.

FIG. **3**B illustrates a side view of the rotatable arm **319** of FIG. **3**A. While the rotatable arm **319** is unpowered, in various embodiments, a rotational drag device can be connected to the rotatable arm **319**, to control the speed of rotation and to limit over-rotation. For example, magnetic brake can be connected to the rotatable arm, at its base **333**. For instance, a magnetic particle brake, such as product MB1-3/16 from Warner Electric, LLC of South Beloit, Ill., USA can be used.

FIG. **3**C illustrates an enlarged side view of the head **337** of the rotatable arm **319** of FIG. **3**B, taking a strand **317** off a side of a package. The rotatable arm **319** includes a first upstream strand guide **340**, a second upstream strand guide (shown in FIG. **3**D), and a downstream strand guide **360**. The first upstream strand guide **340** and the second upstream strand guide **350** are attached at different locations, but are generally configured in the same way. The rotatable arm **319** is taking off the strand **317** in a take-off direction **318-1***a* and over the strand guides, and is directing the strand **317** in an infeed direction **318-1***b* to a downstream infeed location.

The downstream strand guide **360** is attached to the rotatable arm **319** at a downstream strand guide attachment location **361**, which is proximate to the distal end **338** of the rotatable aim **319**. The downstream strand guide attachment

location **361** is spaced apart from the rotational axis **333** of the rotatable arm **319**. The downstream strand guide **360** is an open guide, such that it does not fully constrain the lateral movement of the strand **317**. The downstream strand guide **360** is also dynamic guide, configured to rotate in place. In FIG. **3**C, the downstream strand guide **360** is a grooved wheel, configured to rotate around a shaft **363**.

The first upstream strand guide **340** is also an open guide. A proximal end **343** of the first upstream strand guide **340** is attached to the rotatable arm **319** at a first upstream strand guide attachment location **341**, that is closer to the rotational axis **333** than the downstream strand guide attachment location **361**. The first upstream strand guide **340** is disposed proximate to the downstream strand guide **360**. The downstream strand guide **340** is a static guide, not configured to rotate in place.

The first upstream strand guide **340** has a distal end **344** that is free, which allows the strand **317** to slide off of the distal end **344** without obstruction. The first upstream strand guide **340** has an overall shape that is elongated from the proximal end **343** to the distal end **344**. In FIG. **3**C, the overall shape of the first upstream strand guide **340** is cylindrical, however, in various embodiments, an upstream strand guide can be configured with other shapes. The first upstream strand guide **340** has an upstream strand guide centerline **342**, following the longitudinal axis of the cylindrical shape. The upstream strand guide centerline **342** is parallel with the rotational axis **333**.

The strand guides can be made from various solid materials that are hard and low friction, with a low surface porosity. For example, the strand guides can be made from plastic, metal, ceramic, etc. For instance, for a downstream strand guide, a ceramic idler, such as part #Z-238 from Yuasa can be used.

A ferrous material **370** is optionally attached to the rotatable arm **319**, so that the rotatable arm **370** can be held in place by a magnet. In FIG. **3**C, the ferrous material **370** is attached to the rotatable arm **370** at a location that is proximate to the distal end **338**. Alternatively, the rotatable arm **319** can include a ferrous material as part of a component of the arm. For example, the downstream strand guide **360** can include a bearing made from a ferrous material.

FIG. **3**D illustrates an enlarged front view of the head **337** of the rotatable arm **319** of FIG. **3**C, taking the strand **317** off a side of a package.

FIG. **3**D includes a downstream strand guide reference plane **380** oriented parallel to the groove **366** of the downstream strand guide **360**. In the embodiment of FIG. **3**D, the groove **366** is illustrated as a V-shaped groove, however, in various embodiments, the groove **366** can be a smooth curve, or other shapes known in the art. The downstream strand guide reference plane **380** passes through a deepest part **369** of the groove **366**. The downstream strand guide reference plane **380** is also parallel with the rotational axis **333**. In the embodiment of FIG. **3**D, the reference plan **380** passes through the rotational axis **333**.

The first upstream strand guide **340** has a first outer surface **345** that is disposed on a first side of the downstream strand guide reference plane **380**. The first outer surface **345** has a curve **347** that has a radius with respect to the first upstream strand guide centerline **342**.

The second upstream strand guide **350** is attached to the rotatable arm **319** at a second upstream strand guide attachment location **351**. The second upstream strand guide **350** is disposed proximate to the downstream strand guide **360**. The second upstream strand guide **350** is also an open guide. The second upstream strand guide **350** has a second outer surface **355** that is disposed on a second side of the downstream strand guide reference plane **380**. The second upstream strand guide **350** has a curve **357** that has a radius with respect to a second upstream strand guide centerline **352**. Each of the upstream strand guide centerlines **342** and **352** is substantially parallel to the downstream strand guide reference plane **380**. Also, when the rotatable arm **319** is in its in-use position at a package unwind station, both of the upstream strand guide centerlines **342** and **352** are substantially parallel to the side of the package being unwound.

As used herein, when the word substantially is applied to parallel directions, the word substantially means parallel within 0-30', or any integer value within this range. As used herein, when the word substantially is applied to perpendicular directions, the word substantially means perpendicular within 0-30°, or any integer value within this range.

In FIG. **3**D, all of the first upstream strand guide **340** is disposed on the first side of the downstream strand guide reference plane **380** and all of the second upstream strand guide **350** is disposed on the second side of the downstream strand guide reference plane **380**, however, in various embodiments, this is not required. Also, with respect to the downstream strand guide reference plane **380**, the first upstream strand guide attachment location **341** is symmetrical to the second upstream strand guide attachment location **351**, however, in various embodiments, this is not required.

The downstream strand guide **360** is a grooved wheel, configured to rotate around a cylindrical shaft **363**, with a centerline **362**. The centerline **362** is perpendicular to the reference plane **380** and also perpendicular to each of the upstream strand guide centerlines **342** and **352**.

The downstream strand guide **360** has a strand contact surface **365**, which is the portion of its curved outer surface that is configured for contact with the strand **317** as the strand **317** is being unwound. The strand contact surface **365** has an overall width **368**. The first upstream strand guide attachment location **341** and the second upstream strand guide attachment location **351** are selected such that the first outer surface **345** is spaced apart from the second outer surface **355** by a distance **383** that is less than or equal to the overall width **368**.

Since the rotatable arm **319** has a first upstream strand guide **340** and a second upstream strand guide **350**, positioned and configured as described above, the rotatable arm **319** can take off the strand **317** in a first orientation with the take-off direction **318-1***a* (constrained by the first outer surface **345**) or the rotatable arm **319** can take off the strand **317** in a second orientation (shown in FIG. **3**D by phantom lines) with another take-off direction (constrained by the second outer surface **355**). Whether taking the strand **317** off in the first orientation or the second orientation, the strand guides of the rotatable arm **319** are configured to direct the strand **317** over the downstream strand guide **360** to the downstream infeed location. Thus, with respect to the downstream infeed location, the rotatable arm **319** can be used to unwind a package in either a clockwise or a counterclockwise direction. As a result, the same rotatable arm **319** can be used to unwind packages regardless of how a package is wound or how a package is loaded into the package station.

It is also contemplated that embodiments of the present disclosure can be combined with other structures and features of take-off devices, which are known in the art. For example, it is contemplated that the apparatus **200** of FIG. **2**A can use a splicing apparatus as described in US patent application entitled "Splicing Apparatus for Unwinding Strands of Material" filed on Nov. 4, 2011 by The Procter & Gamble Company under attorney docket number (TBD) in the name of Castillo, et al., which is hereby incorporated by reference.

Embodiments of the present disclosure use a rotatable arm to unwind a strand by taking it off of the side of a wound package. Using the rotatable arm reduces the friction as the strand is being taken off, which is especially useful for tacky strands. As a result, the strand experiences lower tension with less variability. Using the rotatable arm also tends to peel stuck portions away from the side, so that a lower tension in the strand can overcome the sticking forces. As a result, the strand experiences fewer instances of high tension, which leads to fewer breaks and less downtime for the equipment.

The dimensions and values disclosed herein are not to be understood as being strictly limited to the exact numerical values recited. Instead, unless otherwise specified, each such dimension is intended to mean both the recited value and a functionally equivalent range surrounding that value. For example, a dimension disclosed as "40 mm" is intended to mean "about 40 mm."

Every document cited herein, including any cross referenced or related patent or application, is hereby incorporated herein by reference in its entirety unless expressly excluded or otherwise limited. The citation of any document is not an admission that it is prior art with respect to any invention disclosed or claimed herein or that it alone, or in any combination with any other reference or references, teaches, suggests or discloses any such invention. Further, to the extent that any meaning or definition of a term in this document conflicts with any meaning or definition of the same term in a document incorporated by reference, the meaning or definition assigned to that term in this document shall govern.

While particular embodiments of the present invention have been illustrated and described, it would be obvious to those skilled in the art that various other changes and modifications can be made without departing from the spirit and scope of the invention. It is therefore intended to cover in the appended claims all such changes and modifications that are within the scope of this invention.

What is claimed is:

1. An apparatus for unwinding a strand of material, the apparatus comprising:

a frame;

a first package unwind station and a second package unwind station mounted to the frame, wherein each of the first package unwind station and the second package unwind station comprises:

a rotatable arm that includes a base, a rotational axis at the base, and an arm distal end;

a downstream strand guide attached to the rotatable arm at a downstream strand guide attachment location that is spaced apart from the rotational axis, and proximate to the arm distal end, wherein the downstream strand guide is an open guide, and the downstream strand guide includes an outer surface with a groove;

a downstream strand guide reference plane oriented parallel to the groove, passing through a deepest part of the groove and substantially parallel with the rotational axis, with one side of the downstream strand guide reference plane defined as a first side, and another side of the downstream strand guide reference plane defined as a second side;

a first upstream strand guide attached to the rotatable arm at a first upstream strand guide attachment location, wherein the first upstream strand guide is disposed proximate to the downstream strand guide, the first upstream strand guide is an open guide, the first upstream strand guide has a first outer surface that is disposed on the first side of the downstream strand guide reference plane, and the first upstream strand guide has a curve that has a radius with respect to a first upstream strand guide centerline, and wherein the first upstream strand guide is static; and

a second upstream strand guide attached to the rotatable arm at a second upstream strand guide attachment location, wherein the second upstream strand guide is disposed proximate to the downstream strand guide, the second upstream strand guide is an open guide, the second upstream strand guide has a second outer surface that is disposed on the second side of the downstream strand guide reference plane, and the second upstream strand guide has a curve that has a radius with respect to a second upstream strand guide centerline, and wherein the second upstream strand guide is static;

wherein each of the upstream strand guide centerlines is substantially parallel to the downstream strand guide reference plane and substantially parallel to the rotational axis, and

wherein the first package unwind station is configured to receive a first package and the second unwind station is configured to receive a second package, each of the first package and the second package include a front end, and wherein the front end of the first package is angled with respect to the front end of the second package.

2. The apparatus of claim **1**, wherein the arm is an unpowered arm.

3. The apparatus of claim **1**, wherein the downstream strand guide is a dynamic guide.

4. The apparatus of claim **3**, wherein the groove has a curve that has a radius with respect to a downstream strand guide centerline.

5. The apparatus of claim **4**, wherein the downstream strand guide is a grooved wheel.

6. The apparatus of claim **1**, wherein the downstream strand guide attachment location is disposed proximate to the arm distal end.

7. The apparatus of claim **1**, wherein each of the upstream strand guides has an upstream strand guide proximal end attached to the rotatable arm and an upstream strand guide distal end that is free.

8. The apparatus of claim **7**, wherein each of the upstream strand guides has an overall shape that is elongated from its proximal end to its distal end.

9. The apparatus of claim **8**, wherein each of the upstream strand guides has a cylindrical shape.

10. The apparatus of claim **1**, wherein each of the upstream strand guide centerlines is completely parallel to the groove.

11. The apparatus of claim **1**, wherein all of the first upstream strand guide is disposed on the first side of the downstream strand guide reference plane and all of the second upstream strand guide is disposed on the second side of the downstream strand guide reference plane.

12. The apparatus of claim **1**, wherein the downstream strand guide has a strand contact surface with an overall width and the first outer surface is spaced apart from the second outer surface by a distance that is less than or equal to the overall width.

13. The apparatus of claim **1**, wherein, with respect to the downstream strand guide reference plane, the first upstream strand guide attachment location is symmetrical to the second upstream strand guide attachment location.

14. The apparatus of claim **13**, including a ferrous material attached to the arm at a location that is proximate to the arm distal end.

15. The apparatus of claim **1**, wherein the arm includes a counterbalance opposite from the arm distal end.

16. A method for unwinding a strand of material, the method comprising:

providing the apparatus of claim 1;

using the first package unwind station to unwind a first strand from the first package, in a clockwise direction with respect to the downstream infeed location; and

using the second package unwind station to unwind a second strand from the second package, in a counter-clockwise direction with respect to the downstream infeed location.

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